Space Weather Technical Forecast

Issued on Thursday, 05 May 2022 at 13:07 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of further R1/R2 radio blackouts, Slight Chance of R3.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours, with GOES16 recording frequent C-class activity and a trio of M-class flares: an M1.1 at 05/1632UTC; an M1.5 at 05/1948UTC; and finally an M1.6 at 05/2027UTC. Peak activity was roughly equally partitioned between AR3004 near centre-disc, which currently manifests as a Dkc/beta-Gamma-Delta, but also AR3006, which is a more subtle Dao/Beta at the time of writing. The peak flare of the period emanated from AR3004, which is showing a relatively slow growth trend, with migration of intermediate spots into both the leading and trailing groups, as well as some southward motion on the disc. There is a likely delta spot immediately behind the main leading group. AR3006 shows less complexity visually, however it forms part of a large plage, and this may be hiding detail along with the narrow viewing angle. These were two of four current sunspot regions, with the remainder of the front-sided roster populated by stable unipolar groups AR3001 and AR2999, with both designated as Hsx/Alpha.

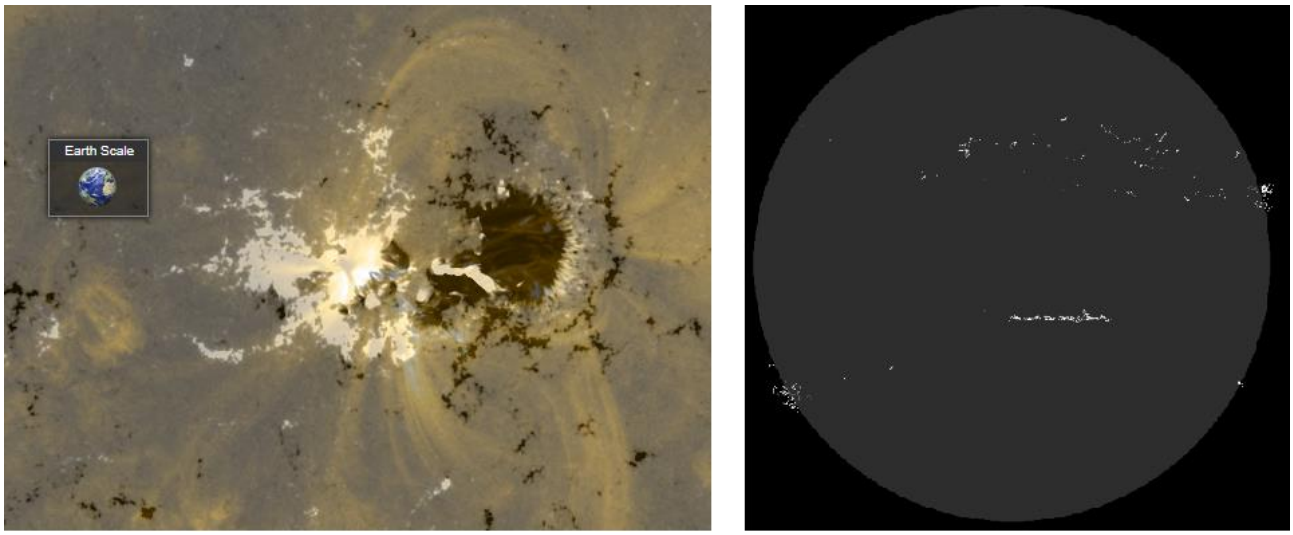

Figure 0: Composite 05/1000UTC HMIB and AIA171 imagery of sunspot region AR3004, with the candidate for a Mt Wilson delta spot appearing as the starkly north-south striped patch behind the large leading spot. Image processing courtesy of Helioviewer.org. Also shown (right) is the location of all flares of C-class and above in the past fortnight, with the central stripe tied to AR3004. Note also the contribution from AR3006 near the southeastern limb. Image courtesy of SIDC ROB.

The Earth-facing side of the disc currently shows strongly demarcated striping in HMIBC imagery in the solar 'tropics', with the result that there are numerous filaments occupying these latitudes. At present all appear stable and there are no Earth-directed Coronal Mass Ejections (CMEs) in available satellite imagery.

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Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR and ACE at L1, followed a slow regime, with the solar wind speed at ACE showing a very slight decline from near-400km/s to finish around 300. The solar wind density was similarly unremarkable in low single-figures ppcc, while the IMF was stable at or below 5nT, with a north-south component of no more than +3/-4nT. The phi angle was negative through the period (towards the sun).

The net effect of the above solar wind measures was Quiet throughout, peaking at a provisional Kp of '2o' in the 21-24UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours.

The high energy electron flux has varied between Moderate and High levels, reaching a peak of 1470 pfu at 04/1440UTC. Electron fluence followed a slightly declining trend, with the 05/0001UTC observed 24-hour integrated value being 5.3e7pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a Chance of further M-class flares from both AR3004 and 3006, with a daily Slight Chance of X-class. No significant groups leave the disc in the period, and the eastern far horizon appears relatively subdued, therefore these risks are held constant through the forecast period.

Solar Wind / Geomagnetic Activity: No coronal holes and no Earth-directed CMEs feature in the forecast, and Quiet geomagnetic activity is therefore most likely.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is at Background levels, and is expected to continue at this level through the period. There is a daily Slight Chance of S1 or above as a result of 3004's westward advance.

The high energy electron flux (greater than 2MeV) is forecast to continue between Moderate and High in its diurnal oscillation, but with an overall slight decline in fluence through the period in the unsupportive current solar wind environment. A daily Chance of Active fluence should therefore fall with time.

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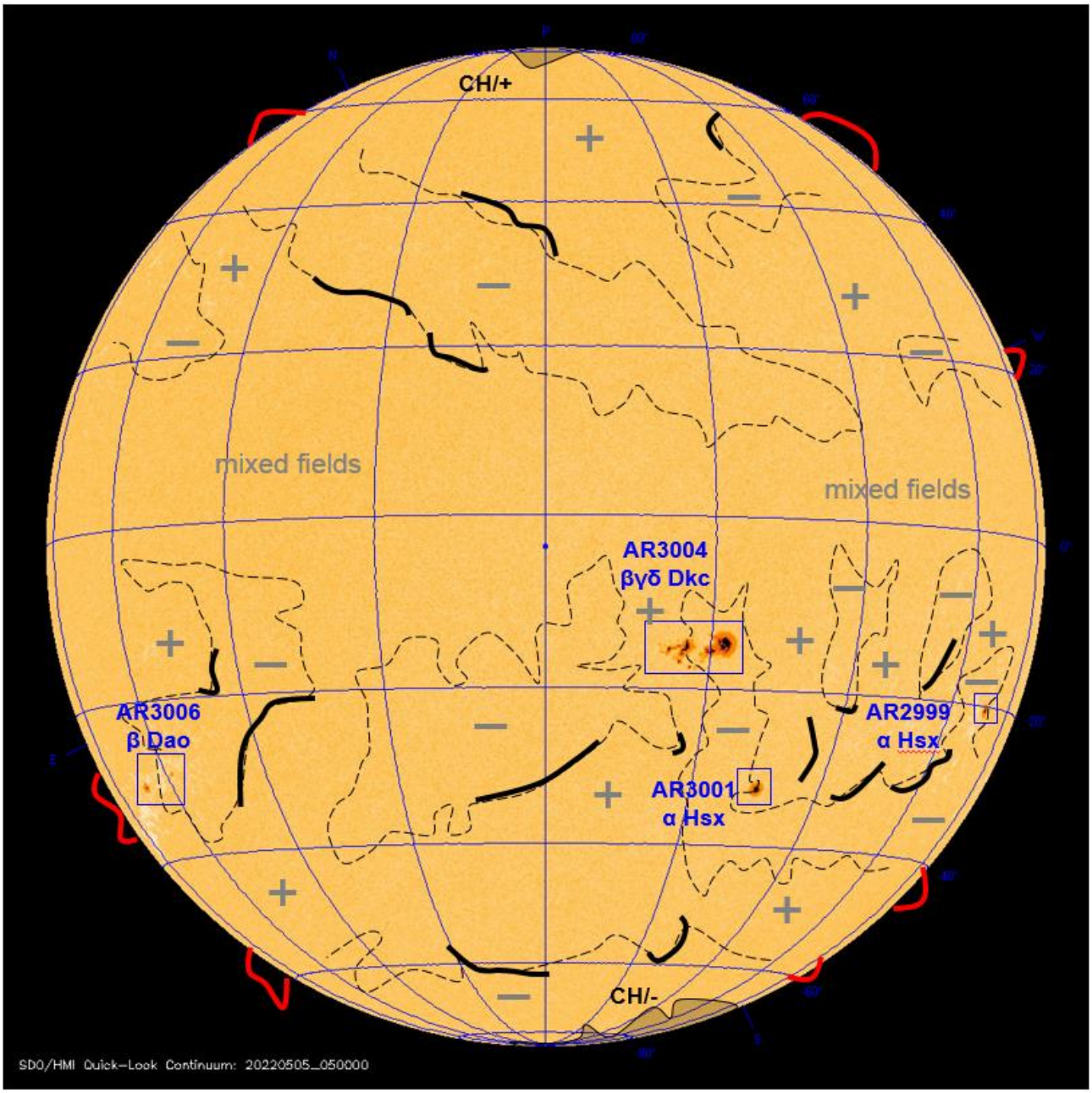
Figure 1. Solar Analysis Valid 05/0500UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

At the time of writing, no coronal holes and no Earth-directed CMEs feature in the forecast, and Quiet geomagnetic activity is therefore most likely throughout.

Having said the above, there are currently signs of a possible weak CIR-like enhancement at STEREO A in MAG and PLASTIC traces, which may correspond to a faint western solar hemisphere coronal hole 2.5 days upstream of Earth in the Parker Spiral. This may be the rationale for a slight increase in forecast solar wind speed in current MOSWOC Enlil runs through day four, Sunday 08 May, although this is not particularly marked and should only perhaps result in Unsettled activity, if indeed it is present at all. This aspect of the forecast uncertainty will become clearer in the next 12 hours or so.

Other points to note are that there are both numerous filaments on the disc at present, and AR3004 currently occupies a central position. Should either of these sources produce CMEs, then the chances of some Earth-directed component are relatively high.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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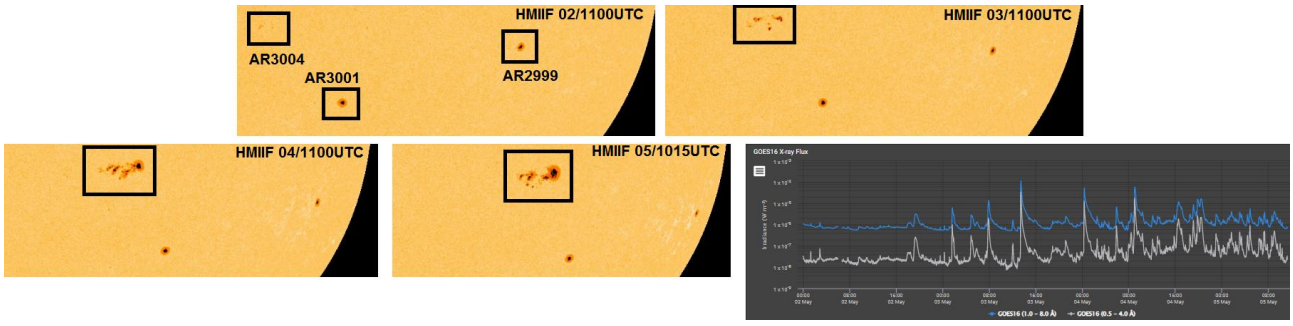
Radio Blackouts - X-Ray Flares:

Activity on the Earth-facing side is expected to be Moderate in the period, with current flux roughly split between the obviously complex AR3004, and the more subtle AR3006. It remains possible that AR3006 is hiding detail in its large containing plage region given its eastward position on the disc, however this is becoming less likely as the angle improves, and it could be that much of its potency is sub-surface, as with recent Ex-2996. In terms of sources of future activity, AR3004's Dkc configuration and marked north-south split delta spot in its intermediate portion are definitely aspects to watch, although perhaps because of its overall stalled growth there has been a recent tendency towards a plateau in activity.

None of the main front side regions leave the disc in the period, and while STEREO A EUVI 195 imagery does suggest at least a plage lying near 110 East at present, this part of the sun does not appear unduly active from coronagraphs.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 2: Time evolution of AR3004, 3001 and 2999 in HMIIF imagery over the past 96 hours. Also shown is GOES16 X-ray flux, with the i9ncrease attributable to both growth in AR3004 but also the rotating onto the front side of AR3006 (not shown).



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days.

Probabilities of exceeding S1 have been raised to a daily Slight Chance however, largely owing to the presence of AR3004 and its Dkc/Beta-Gamma-Delta configuration in the western hemisphere. So far M-class flares from this region have yet to produce any response in protons, which may prove characteristic of this group but is not guaranteed.

Radiation Storms Probability (Exceedance)	**Level (cm^{-2} sr^{-1} s^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC) (%)**	**Day 2 (00-24 UTC) (%)**	**Day 3 (00-24 UTC) (%)**	**Day 4 (00-24 UTC) (%)**
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

While marginal for exceeding 24-hour Active fluence at present, the expected trajectory of electron fluence is downwards in the four days, with the current slow solar wind regime not likely to be capable of restoring any daily losses from the Van Allen belts in minor geomagnetic activity. Even with the current slight question mark surrounding STEREO A's possible current enhancement, the effect on 24-hour integrated fluence will still most likely fall outside the forecast period.

GEO Electron Environment Probability (Exceedance)	**Level (cm^{-2} sr^{-1} day^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC) (%)**	**Day 2 (00-24 UTC) (%)**	**Day 3 (00-24 UTC) (%)**	**Day 4 (00-24 UTC) (%)**
Active	**≥ 2 MeV ≥ $1x10^8$**	No	40	30	30	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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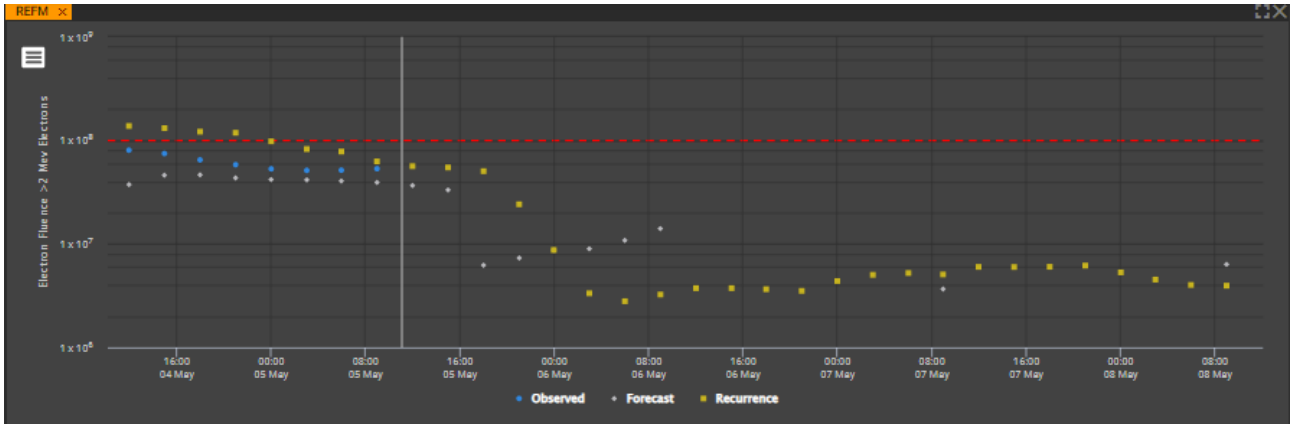
Figure 3: MOSWOC REFM, showing accepted downward trend in fluence over the next 3 days, in a similar manner to last rotation.



NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.

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